

Lesson: Historical and Current Floodplain Analysis

Name _____

Skills Involved:

- 1) Analyzing vector and raster data in a floodplain study.
- 2) Integrating text and ground photographs in GIS analysis.
- 3) Intersecting data sets.

This lesson uses ArcGIS 9 from ESRI, Inc.

Purpose of Activity:

- 1) Understand how floods occur, and why floodplains are important to communities, with a case study of Boulder, Colorado, USA.
- 2) Understand the history and geography of the Fourmile Canyon Creek Floodplain.
- 3) Understand the implications of development along the Fourmile Canyon Creek Floodplain.

Data Management

Create a folder for this exercise and name it *boulderflood*. As you know, it is best to name the folder without any spaces in the name.

Go to the site given by your instructor for the data you will need for this lab exercise:

This file is named **boulderfloodlesson.zip** and totals approximately 12 MB.

After downloading, unzip the file using the Winzip program.

You now should have files with the following names: west37, hydronew, 100year, 500year, rdctrline, bldgs, cities, schools, mainroads, and a few additional files.

Flash floods are a problem in mountainous areas because runoff from rainfall is constrained to narrow river valleys. Cities where rivers flow out onto the Great Plains are particularly vulnerable to flash flooding.

Start ArcGIS with a blank map document and add the following layers:

Streams (hydronew)
Lakes
100 year floodplain
500 year floodplain
main roads
road centerlines
cities

The data are in projected – state plane – NAD 1983, Colorado North Zone. Set this in your Data Frame Properties.

1) What are your map and distance units?

2) What is the primary direction that the creeks flow in this area?

from _____ **to** _____

3) Why?

4) Which should be larger in spatial extent—a 100 year flood event or a 500 year flood event? Why?

5) In your data for Boulder, does the 500 year floodplain include all of the areas that could be underwater in a 100-year flood?

Therefore, you'll need to merge the two layers to obtain the areas that would be underwater in a true 500 year flood event. As you know, before you merge layers, you need to become familiar with the attribute tables of the layers to merge.

6) How do the fields attribute tables for the two flood layers compare? Which is more complete?

7) How many records are in each data set?

The 100 year floodplain: _____

The 500 year floodplain: _____

Use the Union function in the Analysis portion of ArcToolbox to combine the two layers, using the ALL fields, naming the result: true500floodplain.

8) How many records does the attribute table for true500floodplain have?

9) Why?

Find Boulder Creek and Fourmile Canyon Creek (north side of Boulder).

10) Measure the width of the Boulder Creek and the Fourmile Canyon Creek floodplain between the three points indicated below, and fill in the table:

	Boulder Creek	Fourmile Canyon Creek
Broadway		
28 th Street		
Foothills Parkway / Diagonal Highway		

11) Measure the width of the combined floodplain east of the city, at 61st Street.

12) What do you notice about the width of the floodplains as you move from west to east across Boulder? Why?

13) If all of the streams in the city of Boulder were at the 100-year flood level, what is the approximate percentage of the city of Boulder that would be covered in a 100 year flood based on your observation of the map?

14) If all of the streams in the city of Boulder were at the 500-year flood level, what is the approximate percentage of the city of Boulder that would be covered in a 500 year flood based on your observation of the map?

15) What is the problem with the areas in the attribute tables of some of these shape files?

16) What type of data structure would be better than shape files to use for analyzing the areas of the floodplain polygons?

17) What attribute of streams (hydronew) contains the *type* of water feature (ditch, intermittent, perennial, etc)?

Symbolize the hydro layer based on your answer above.

18) Looking at your data, what type of stream are floodplains most commonly associated with?

19) What type of stream is the Boulder Creek floodplain associated with? Circle your answer.

Perennial Stream

Intermittent Stream

Irrigation Ditch

20) What type of stream is the Fourmile Canyon Creek floodplain associated with? Circle your answer.

Perennial Stream

Intermittent Stream

Irrigation Ditch

21) Can a river flood even if it is not flowing all the time? Why or why not?

Add the buildings layer.

22) In what part of the city is the largest building within the city limits of Boulder?

23) How did you answer the above question?

24) This is the IBM Building. Is this building in a floodplain?

Clear your selection.

25) How many buildings are in the 100 year floodplain?

26) How did you answer the above question?

27) In what part of the city is the largest building in the 100-year floodplain?

Export the buildings in the 100 year floodplain to a separate layer called 100yearbuildings.shp.

Use the “zoom to selected” function to zoom to the selected building.

Add the schools layer.

28) What school is the largest building in the 100 year floodplain?

29) How many buildings are in the 500 year floodplain?

30) How did you answer the above question?

31) In what part of the city is the largest building in the 500 year floodplain?

This is Boulder’s Crossroads Mall in Boulder.

32) Compare, in your own words, the relative danger of the largest building in the 100-year floodplain versus the largest building in the 500-year floodplain. Identify at least three factors that affect the level of danger for each.

33) What do you think would be the two best types of land use or building types in a floodplain? Why?

Select all of the public schools inside 100 year floodplain.

34) How many of the public schools within the city of Boulder are within the 100 year floodplain?

35) How did you answer the above question?

36) How many of the public schools within the city of Boulder are within the 500 year floodplain?

37) Compare the number of schools in the 100 year floodplain to that in the 500 year floodplain.

38) What is the only public school within the Four Mile Canyon Creek floodplain?

Next, examine Four Mile Canyon Creek in more detail by using the resources of BASIN, the Boulder Area Sustainability Information Network. Funded by the Environmental Protection Agency (EPA), BASIN is a public website that provides information about the Boulder Creek watershed. You will focus your examination on one small portion of the watershed—Fourmile Canyon Creek in North Boulder.

Fourmile Canyon Creek is a typical portion of the Boulder Creek watershed. It has had several flood events in the last 100 years, and most of the time is it a very unimposing watercourse. In fact, water flows in the creek only four to five months of the year or after fairly substantial rains.

The articles you will be reading deal with the characteristics of the creek and its flood history over the last 100 years. Start by going to the BASIN website:

www.basin.org

Select: Theme: Watershed

Select: Under "Inside the Watershed," select Fourmile Canyon Creek.

39) Give the watershed address of Fourmile Canyon Creek:

40) Approximately where does the creek begin and end?

The 100-year flood flow for Fourmile Canyon Creek is 3,520 cubic feet per second at Broadway. Go to the Boulder Creek watershed on the website.

41) What would be the flow in cubic feet per second at Broadway in a 100-year flood along Boulder Creek?

Go to the web site (and note the underscores in the web site below).

http://waterdata.usgs.gov/co/nwis/uv/?site_no=06730200&PARAMeter_cd=00065.00060

Alternatively, go to:

<http://waterdata.usgs.gov/co/nwis/current/?type=flow>

and search the page for Boulder Creek. This is the USGS stream gage:

BOULDER CR AT NORTH 75TH ST NR BOULDER

42) How many CFS are flowing right now through the gaging station?

43) How many more times the current flow is the 100 year flow? Show your work.

44) Is this gaging station upstream or downstream from the Fourmile Canyon Creek area you are examining?

Go back to Fourmile Canyon Creek on the web site. Also examine (using any image program or even ArcGIS) the ground photograph `broadway_culvert.jpg` that you downloaded earlier along with your spatial data. This is where Broadway spans Fourmile Canyon Creek.

45) What is the problem with the roadway bridge over Fourmile Canyon Creek at Broadway?

46) How might this explain the shape of the floodplain west of Broadway in a 100-year flood?

47) What does "cubic feet per second" mean?

48) What does “100-year flood” mean?

There have been two periods of recorded major flood events. The first was at the beginning of the 20th Century. The second was at the midpoint of the century. The articles listed on the website discuss floods during both periods. Read all of the articles, and then answer the following questions.

Go to the articles by clicking on the 1916, 1950, 1951, and 1955 history of flash floods, under Basin History.

49) In the 1916 flood, how far up the canyon did the rain fall that caused the flood?

50) On what day did each of the floods occur that you read about?

1916 _____

1950 _____

1951 _____

1955 _____

51) Therefore, what is the dominant flood season?

52) What seems to be the cause of the fact that Fourmile Canyon Creek now only has water in it a small portion of the year? Explain.

53) Using any image program or even ArcGIS, examine the ground photograph overchannel_to_w.jpg, taken by Joseph Kerski in January 2002 about 1km west of Broadway along Fourmile Canyon Creek, looking west. Is this creek anything we really need to worry about? Why or why not?

54) List two characteristics that you noticed that were common to all of these flood events.

Add the 1937 aerial photograph west37.

55) What is the predominant land use in this area in 1937?

Turn on the 100 year and 500 year floodplains layers. Turn the floodplains on and off several times so that you can examine the photograph underneath or use the transparency feature in the Effects tools menu.

56) What evidence can you find on the photo for the fact that it has flooded at several points in its history?

57) What is the predominant land use in this area in 1999 (indicated by streets) east of Broadway? West of Broadway?

58) How many people would you estimate to live in the area in 1937 that is covered by the 1937 aerial?

59) How many people would you estimate to live in the area covered by the 1937 aerial in 1999?

60) Name two features that existed in 1937 that still exist today.

61) Name two features that do not exist today but existed in 1937.

62) Name two features that did not exist in 1937 but exist today.

63) Is development getting closer to or encroaching on the floodplain? Explain.

- 64) Which buildings do you believe to be most in danger of being flooded? Explain.
- 65) How many buildings are inside the Fourmile Canyon floodplain in this area?
- 66) How did you answer the preceding question?
- 67) What are the implications of building in and near the floodplain?
- 68) Fort Collins and the CSU campus suffered a damaging, fatal flood in 1997. What are the other communities along the Colorado Front Range besides Boulder and Fort Collins that would be affected by a major flood?
- 69) Summarize in a few sentences what you have learned about using spatial data and tools for flood analysis.

*** End of Lesson 4 ***